

**EXPANDED
FUNCTIONAL FLOWS
&
DESCRIPTIONS
Volume VI of VI**

Prepared for

**National Aeronautics and Space Administration
Marshall Space Flight Center
Huntsville, Alabama**

by

**Grumman Aerospace Corporation
Bethpage, New York 11714**

Contract No. NAS 8-31102

OPERATIONS PLANNING SIMULATION

MODEL EXTENSION STUDY

FINAL REPORT

REPORT NO. SU OPS-RP-75-0001

PREPARED FOR
THE GEORGE C. MARSHALL SPACE FLIGHT CENTER
HUNTSVILLE, ALABAMA

CONTRACT NUMBER
NAS8-31102

PREPARED BY
GRUMMAN AEROSPACE CORPORATION
PRODUCT SUPPORT DEPARTMENT
BETHPAGE, NEW YORK

DATE: 1 February 1975

D. A. Marks, Study Manager
R. E. Gendiellee
T. M. Kelly
M. A. Giovannello

OPERATIONS PLANNING SIMULATION MODEL STUDY
(Contract NAS8-31102)

This is the final report of Contract NAS8-31102 and is submitted by the Grumman Aerospace Corporation, Bethpage, N. Y., in accordance with the terms and conditions of the contract.

The final report is packaged in six (6) volumes, entitled:

- Volume I - Long Duration Exposure Facility (LDEF), Payload No. ST-01-A
- Volume II - Life Sciences Shuttle Laboratory, Payload No. LS-09-S
Biomedical Experiments Scientific Satellite, Payload No. LS-02-A
- Volume III - Dedicated Solar Sortie Mission (DSSM), Payload No. SO-01-S
- Volume IV - Magnetic Spectrometer, Payload No. HE-15-S
- Volume V - Mariner Jupiter Orbiter (MJO), Payload No. PL-12-A
- Volume VI - Expanded Functional Flows and Descriptions

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SUMMARY

I Study Objective

The objective of the Study was to evaluate the Launch Site Facility Requirements Data Sheets for selected Automated and Sortie Payloads.

The Study achieved the objective by:

- o Expanding the NASA launch site Level O functional flow activities to a depth required to identify payload launch site facility and support requirements (Volume VI contains the generic functional flow activities for Automated and Sortie payloads).
- o Conducting analyses of the payload definitions contained in the Level B Data issued by SSPD from the launch site ground processing viewpoint.
- o Processing the payloads through the expanded functional flow activities, and identifying the launch site facility and support requirements.
- o Comparing the generated requirements with those contained in the Launch Site Facility Requirements Data Sheets.

II Study Recommendations

Recommendations from the Study include:

- o Expansion and revision as appropriate of the Level B Data (SSPD) to define in detail the payload ground requirements, based upon the launch site functional flow activities, as well as performing Level II (not Level III) integration at the launch site.

Specific data sheets involved are:

- On-Orbit Checkout/Monitor/Control Equipment (Data Sheet No. A-9 and A-12)
- SKETCHES (Data Sheets No. A-10, S-5, and S-6), with emphasis on the configurations at launch site arrival and installed in Orbiter cargo bay.
- Interface Diagrams (Data Sheet No. S-7) showing the interfaces for monitoring and checkout during launch site ground processing.
- Data and Communications Checkout and Deployment Support/On-orbit Operations Support (Data Sheets No. A-14, A-15, S-19, and S-20).
- Launch/Landing Support Requirements (Data Sheets No. A-18 and S-22).
- Ground Facility Requirements (Data Sheets No. A-19 and S-23).
- Ground Environmental Limits (Data Sheets No. A-20 and S-24).

SUMMARY (Continued)

II Study Recommendations (Cont'd.)

- o Definition and descriptions to Level 4 or 5 of the launch site functional flow activities.
- o Investigation of payload ground requirements at the launch site which are identified as cost drivers for ground processing in this report.

III Future Investigative Areas

Cost effective processing of payloads at the launch site requires further studies and analyses. One area which would provide fruitful results is the generation of detail scenarios of representative payloads by disciplines for Payload Working Groups approval/modification. These detail scenarios would include the ground processing for:

- o Block 1.0 Activities - Payload Prepermission Processing
- o Block 2.0 Activities - Orbiter/Payload Integration and Checkout
- o Block 3.0 Activities - Prelaunch and Launch Operations
- o Block 4.0 Activities - Recovery Operations
- o Block 5.0 Activities - Post Mission Processing

Descriptions and required outline drawings would be provided to define in detail such ground functions and configurations as:

- o Payload and associated ground control and support equipment launch site arrival configurations, transportation and environmental modes, and arrival servicing and inspection/monitoring requirements.
- o Payload calibration
- o Monitoring
- o Checkout
- o Servicing
- o Intra-launch site transportation

The Grumman Aerospace Corporation would be pleased to assist the NASA/MSFC in performing additional studies and analyses to implement effective payload ground processing.

EXPANDED FUNCTIONAL FLOWS AND DESCRIPTIONS

This volume contains the expanded functional flows and descriptions for both Automated and Sortie Payloads at the launch site. For reference, the NASA Level 0 Baseline functional flows are included.

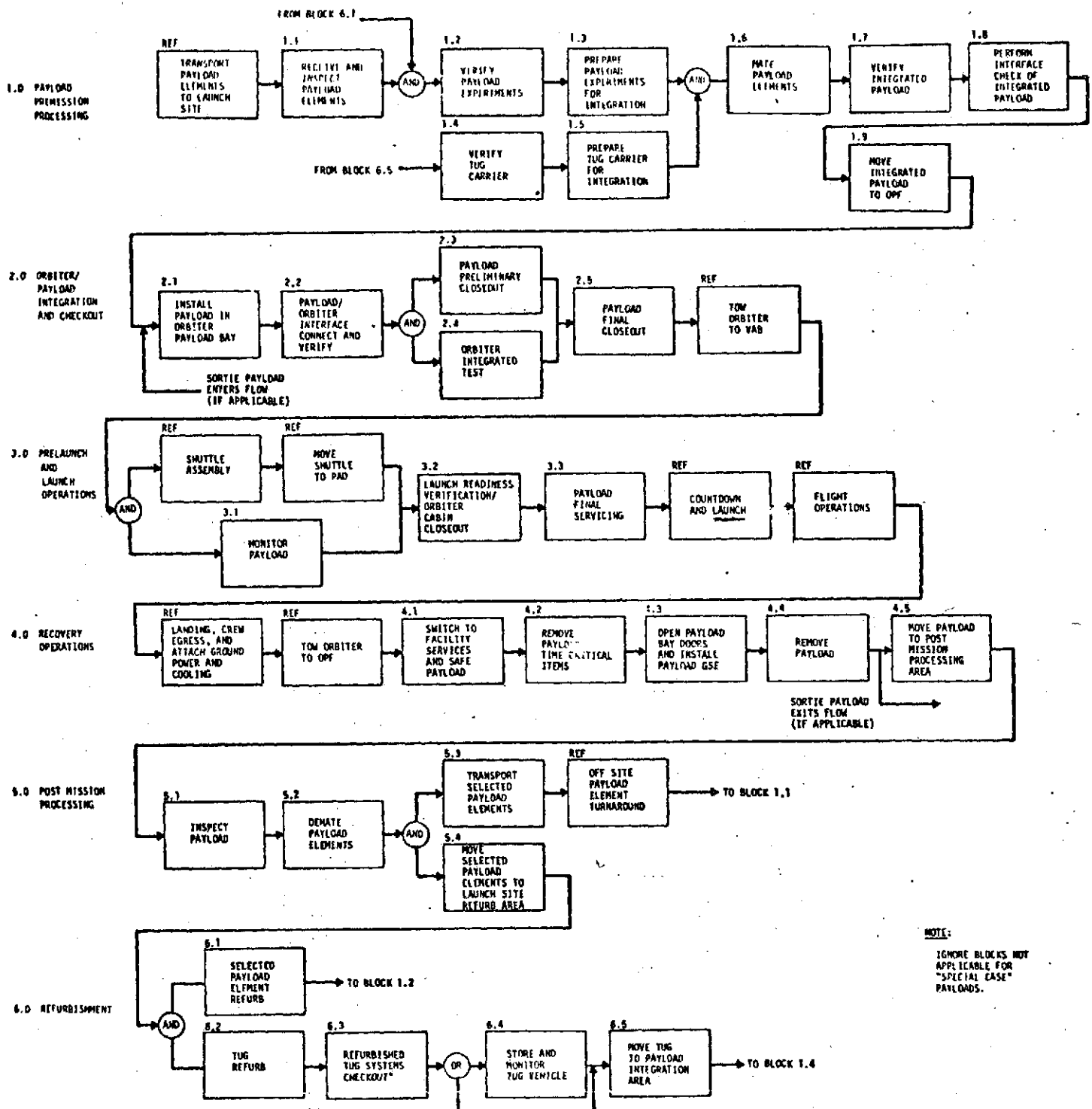
The material is arranged in the following sequence:

o Automated Payload Functional Flows

- NASA Level 0 Baseline Functional Flow
- Block 1.0 Activities (Payload Prepermission Processing)
- Block 2.0 Activities (Orbiter/Payload Integration and Checkout)
- Block 3.0 Activities (Prelaunch and Launch Operations)
- Block 5.0 Activities (Post Mission Processing)

o Sortie Payload Functional Flows

- NASA Level 0 Baseline Functional Flow
- Block 1.0 Activities (Payload Prepermission Processing)
- Block 2.0 Activities (Orbiter/Payload Integration and Checkout)
- Block 3.0 Activities (Prelaunch and Launch Operations)
- Block 5.0 Activities (Post Mission Processing)



LEVEL 0 BASELINE

AUTOMATED PAYLOAD FUNCTIONAL FLOW

AUTOMATED FLOW

Block 1.1 Receive and Inspect Payload Elements

- 1.1.1 Payload elements arrive at launch site via _____
- 1.1.2 Unload payload elements from commercial carrier and place
in temporary storage.
- 1.1.3 Transport payload elements from temporary storage to
receiving area of PPF.
- 1.1.4 Unpack payload elements and place in Holding Fixture
(moveable, and simulates Orbiter Cargo Bay).
- 1.1.4.1 Transport P/L element shipping containers to temporary/
long-term storage.
- 1.1.5 Conduct visual inspection and record transport sensor
readings to verify post-transportation integrity.
- 1.1.5x Contingency node for malfunction correction.
- 1.1.6 Move payload elements to checkout area in PPF.
- 1.1.20 Payload GSE arrives at launch site via _____
- 1.1.21 Unload GSE from commercial carrier and place in temporary
storage.
- 1.1.22 Transport GSE from temporary storage to receiving area of PPF.
- 1.1.23 Unpack GSE, and place on dolly
- 1.1.23.1 Transport GSE shipping containers to temporary storage
- 1.1.24 Conduct visual inspection and record transport sensor
readings to verify post-transportation integrity
- 1.1.24x Contingency node for malfunction correction
- 1.1.25 Move GSE to checkout area of PPF

Block 1.2 Verify Payload Experiments

- 1.2.1 Perform functional check and calibration of GSE
- 1.2.1x Contingency mode for malfunction correction of GSE
- 1.2.2 ^{UN}~~Correct~~ GSE to payload experiments requiring calibration,
and calibrate payload experiments
- 1.2.2x Contingency mode for malfunction correction
- 1.2.3 Connect GSE to payload experiment interfaces
- 1.2.4 Perform verification tests of payload experiment
- 1.2.4x Contingency mode for malfunction correction interfaces
- 1.2.4.1 Perform electrical interface verification tests
- 1.2.4.2 Perform fluid interface verification tests
- 1.2.4.3 Perform mechanical interface verification tests
- 1.2.5 Remove payload experiments verification GSE

Block 1.3 Prepare Payload Experiment for Integration

- 1.3.1 Remove protective covers from interfaces with Upper Stage
(Tug, OOS, Kick Stage, etc.) and Access equipment
- 1.3.2 Perform functional check and calibration of GSE as required
- 1.3.2x Contingency node for malfunction correction
- 1.3.3 Connect GSE to interfaces with Upper Stage
- 1.3.4 Perform interface verification tests with Upper Stage
- 1.3.4x Contingency node for malfunction correction
- 1.3.4.1 Perform electrical interface verification tests
- 1.3.4.2 Perform fluid interface verification tests
- 1.3.4.3 Perform mechanical interface verification tests
- 1.3.5 Remove interface verification GSE

Block 1.4 Verify Tug Carrier

(This block is not applicable to Payload processing)

Block 1.5 Prepare Tug Carrier for Integration

(This block is not applicable to Payload processing)

Block 1.6 Mate Payload Elements

1.6.1 Prepare Holding Fixture for receipt of Payload experiment
and Upper Stage

1.6.2 Position and secure Holding Fixture

1.6.3 Attach handling equipment to Payload experiment and position
in Holding Fixture

1.6.4 Attach handling equipment to Upper Stage and position in
Holding Fixture. (This block is not applicable to Payload
processing).

1.6.5 Connect interfaces between Payload experiment and Upper Stage

1.6.5x Contingency mode for malfunction correction

1.6.5.1 Connect mechanical interfaces

1.6.5.2 Connect fluid interfaces

1.6.5.3 Connect electrical interfaces

Block 1.7 Verify Integrated Payload

- 1.7.1 Perform functional check and calibration of GSE
- 1.7.1x Contingency node for malfunction correction
- 1.7.2 Connect GSE
- 1.7.3 Perform calibration as required on integrated payload
- 1.7.3x Contingency node for malfunction correction
- 1.7.4 Perform verification tests of interface between payload
experiment and Upper Stage
- 1.7.4x Contingency node for malfunction correction
- 1.7.4.1 Perform mechanical interface verification tests
- 1.7.4.2 Perform fluid interface verification tests
- 1.7.4.3 Perform electrical interface verification tests
- 1.7.5 Remove interface verification GSE

Block 1.8

ADDED BLOCK

Perform Interface Check of Integrated Payload

Configure, service, and move orbiter simulator to Holding Fixture. Perform verification of orbiter simulation interfaces for:

- o Fluid servicing
- o Electrical servicing

(This block is not applicable to payload processing)

- 1.8.1 Perform functional check and calibration of GSE
- 1.8.1x Contingency node for malfunction correction
- 1.8.2 Connect GSE
- 1.8.3 Perform verification tests of interface between integrated Payload and Orbiter Simulator.
- 1.8.3x Contingency node for malfunction correction
- 1.8.3.1 Perform Mechanical interface verification tests
- 1.8.3.2 Perform fluid interface verification tests
- 1.8.3.3 Perform electrical interface verification tests
- 1.8.4 Disconnect GSE
- 1.8.5 Connect Orbiter Simulator and Integrated Payload
- 1.8.6 Perform verification tests of interfaces between integrated Payload and Orbiter Simulator
- 1.8.6x Contingency node for malfunction correction
- 1.8.6.1 Perform mechanical interface verification tests
- 1.8.6.2 Perform fluid interface verification tests
- 1.8.6.3 Perform electrical interface verification tests
- 1.8.7 Disconnect and move clear the Orbiter Simulator from Holding fixture

Block 1.9

ADDED BLOCK

Move Integrated Payload to OPF (Orbiter Processing Facility)

Service non-time critical items in Integrated Payload

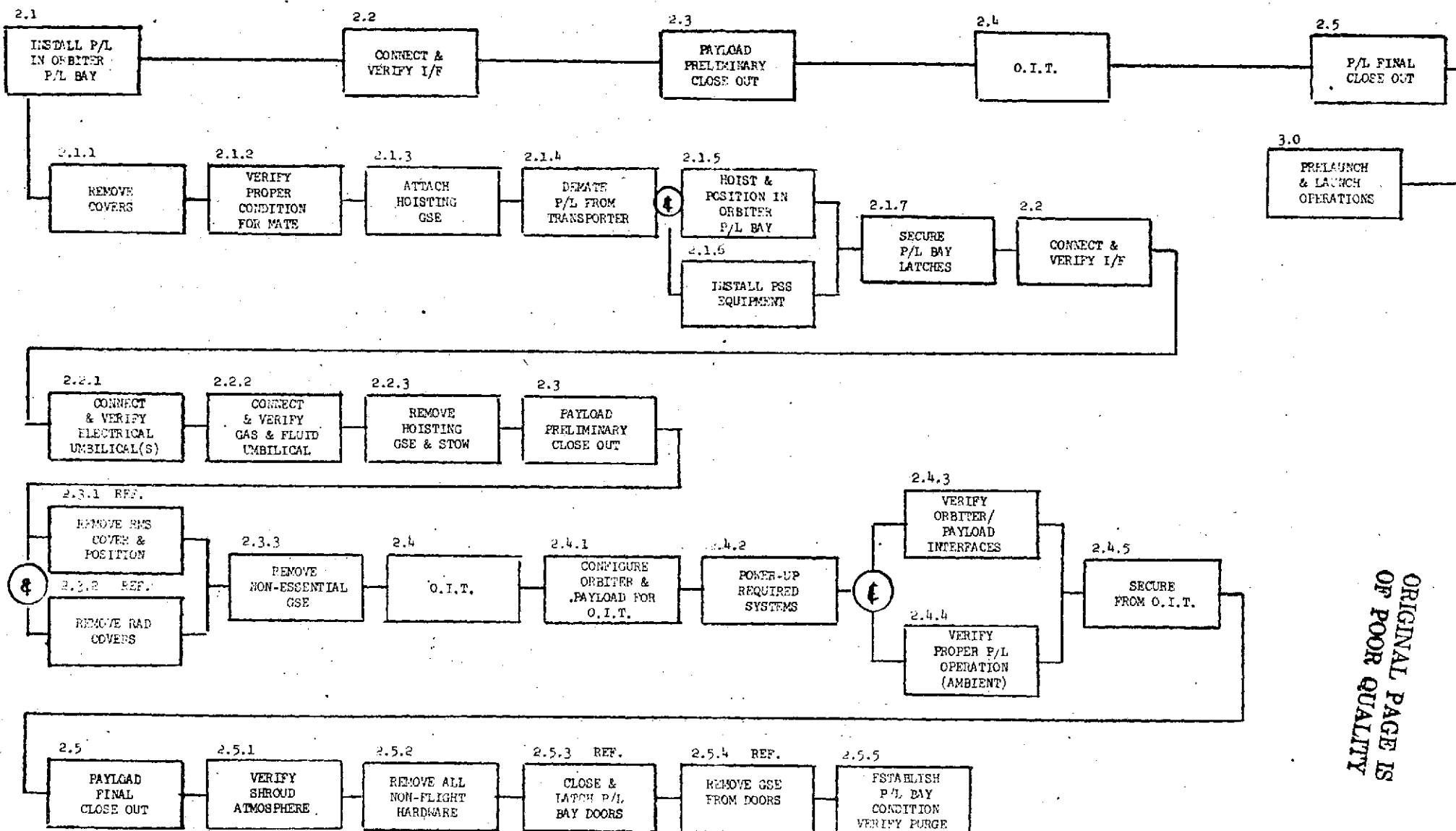
1.9.1 Install protective environmental cover

1.9.2 Install and actuate portable GSE to provide environmental control and other support as required during tow from PPF to OPF

1.9.2x Contingency mode for malfunction correction

1.9.3 Attach tractor to Holding Fixture

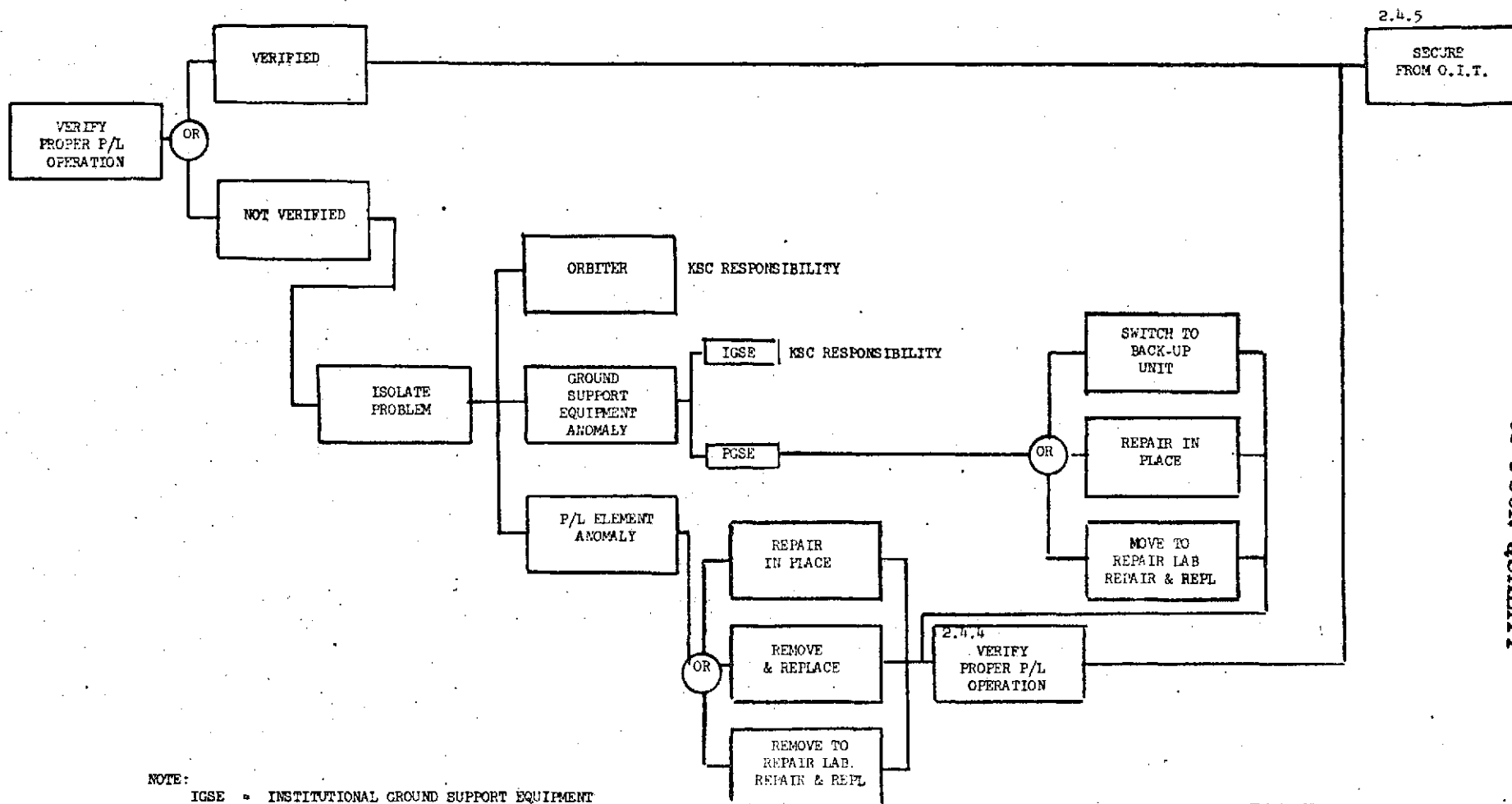
1.9.4 Open PPF doors and tow to OPF



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BLOCK 2.0

ORBITER/PAYLOAD INTEGRATION AND CHECKOUT



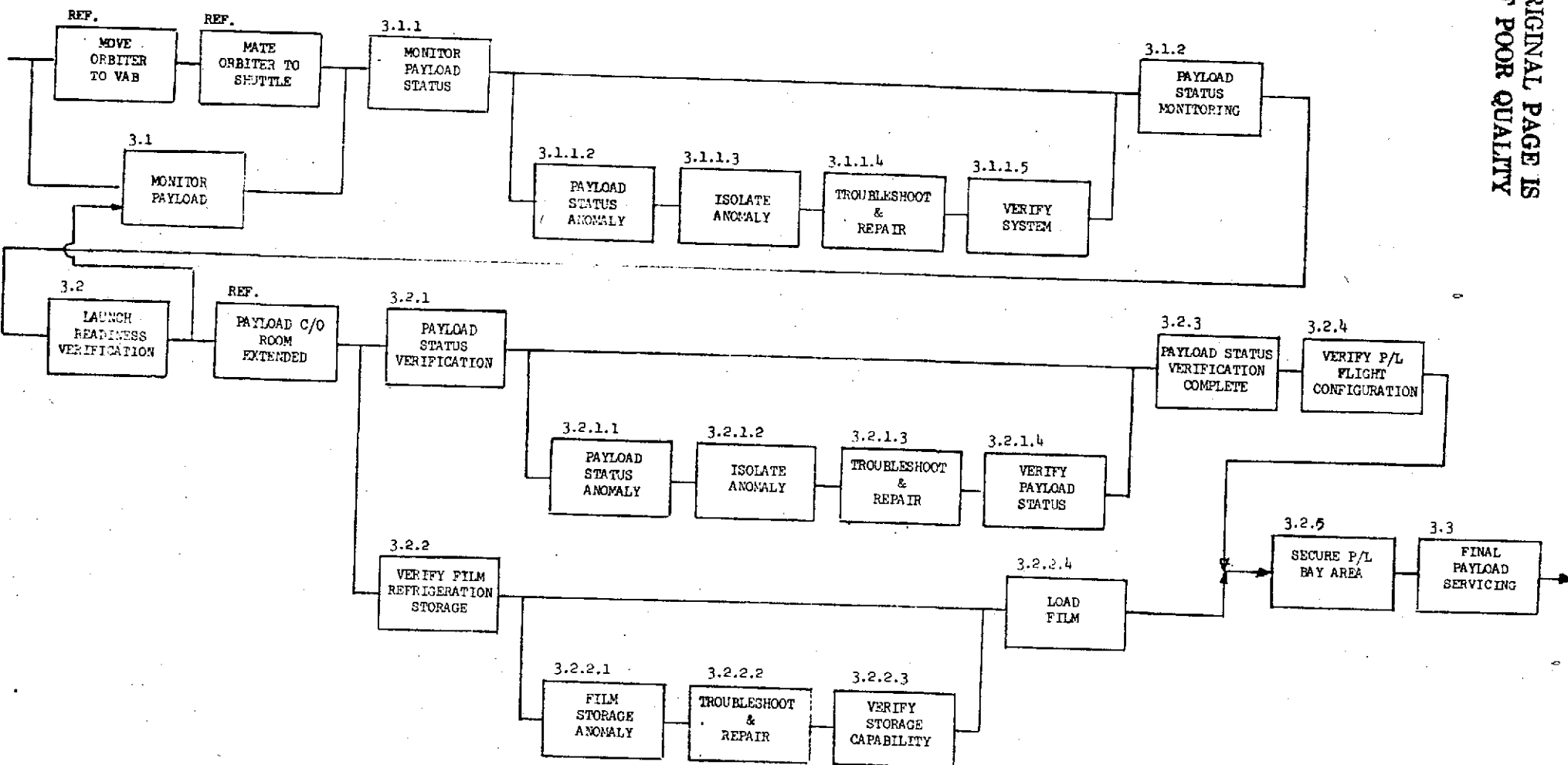
NOTE:

IGSE = INSTITUTIONAL GROUND SUPPORT EQUIPMENT
PGSE = PAYLOAD PECULIAR GROUND SUPPORT EQUIPMENT

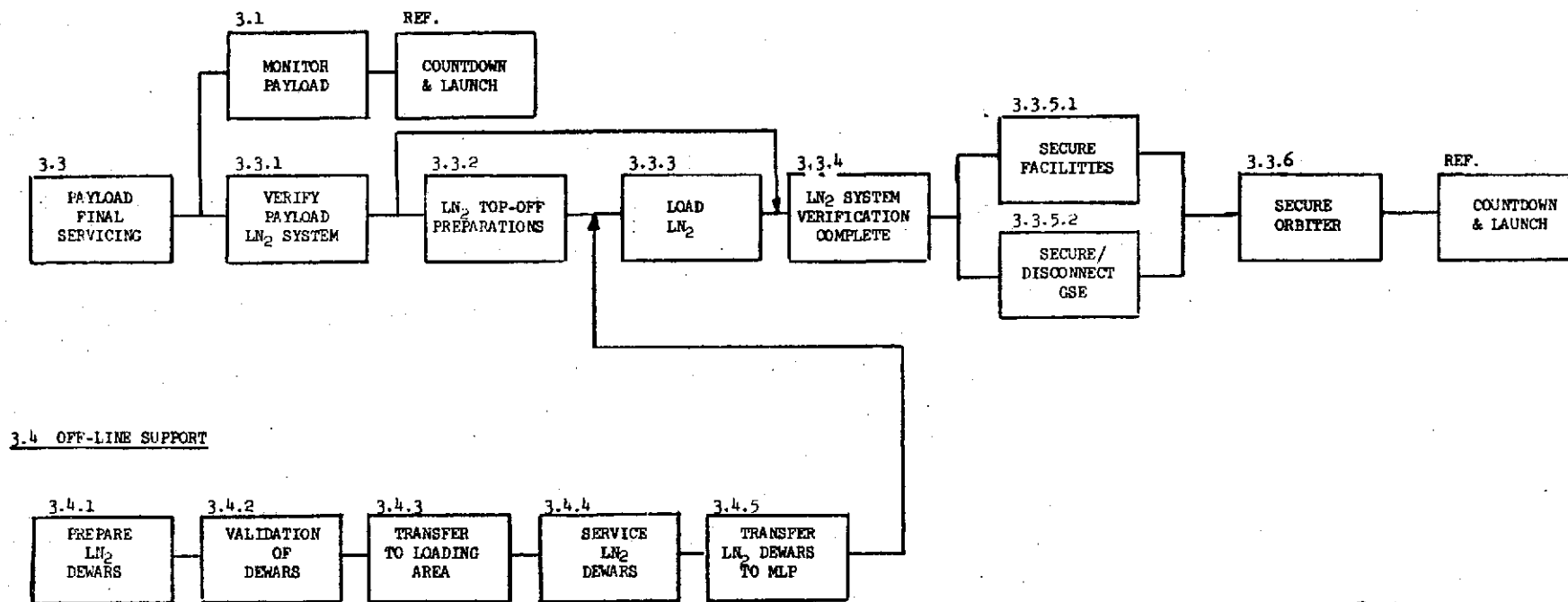
BLOCK 2.0

TYPICAL ANOMALY FUNCTIONAL LOOP

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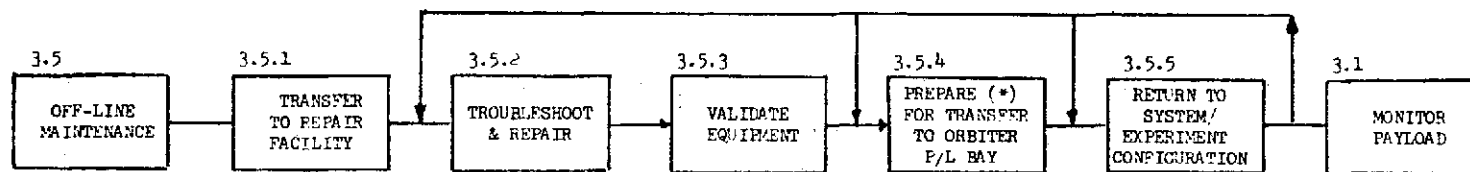


BLOCK 3.1 MONITOR PAYLOAD AND 3.2 LAUNCH READINESS VERIFICATION



BLOCK 3.3 - FINAL PAYLOAD SERVICING

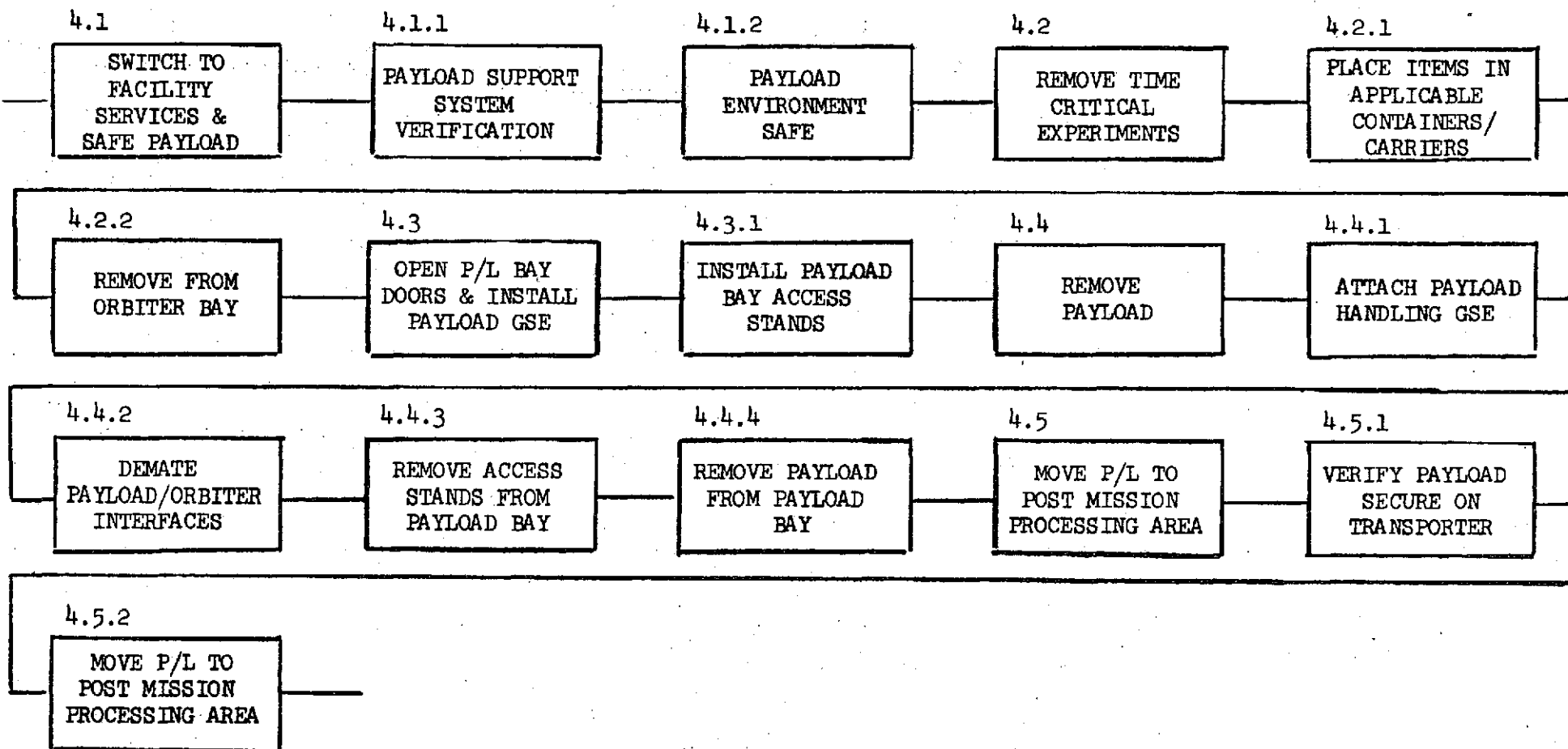
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BLOCK 3.0 - PRELAUNCH AND LAUNCH OPERATIONS

TYPICAL EXPERIMENT/PAYLOAD/GSE - OFF-LINE MAINTENANCE FLOW

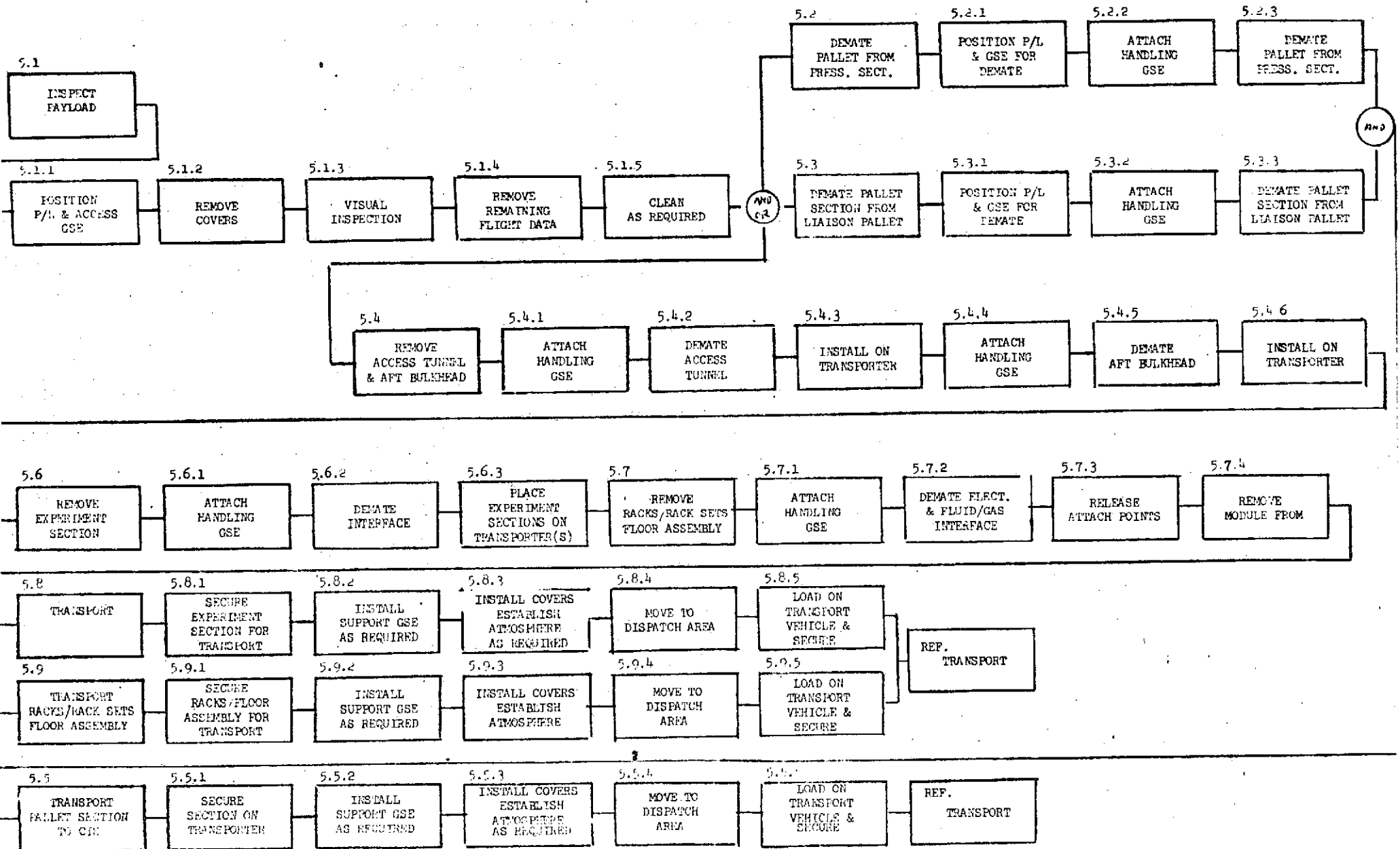
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BLOCK 4.0 POST LANDING OPERATIONS

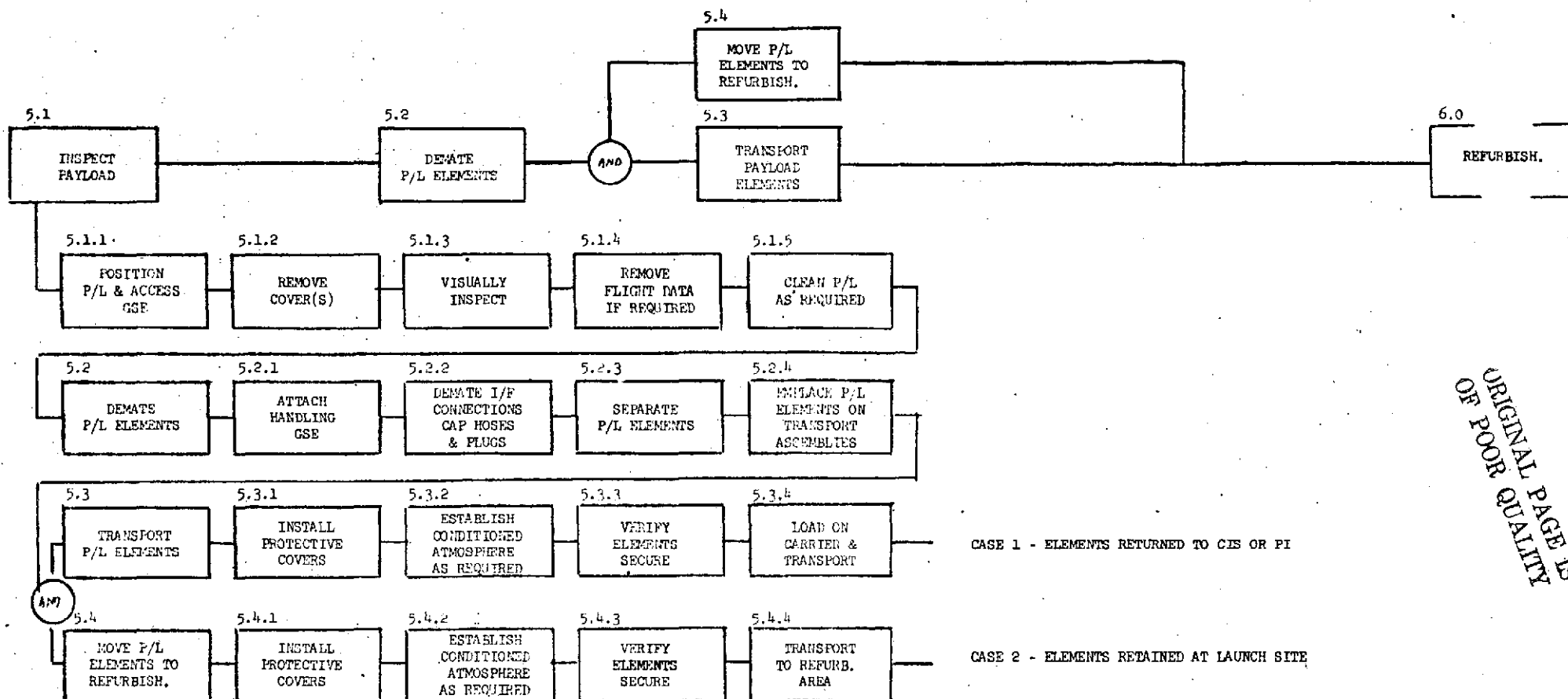
BLOCK 5.0

POST MISSION PROCESSING



BLOCK 5.0

POST MISSION PROCESSING



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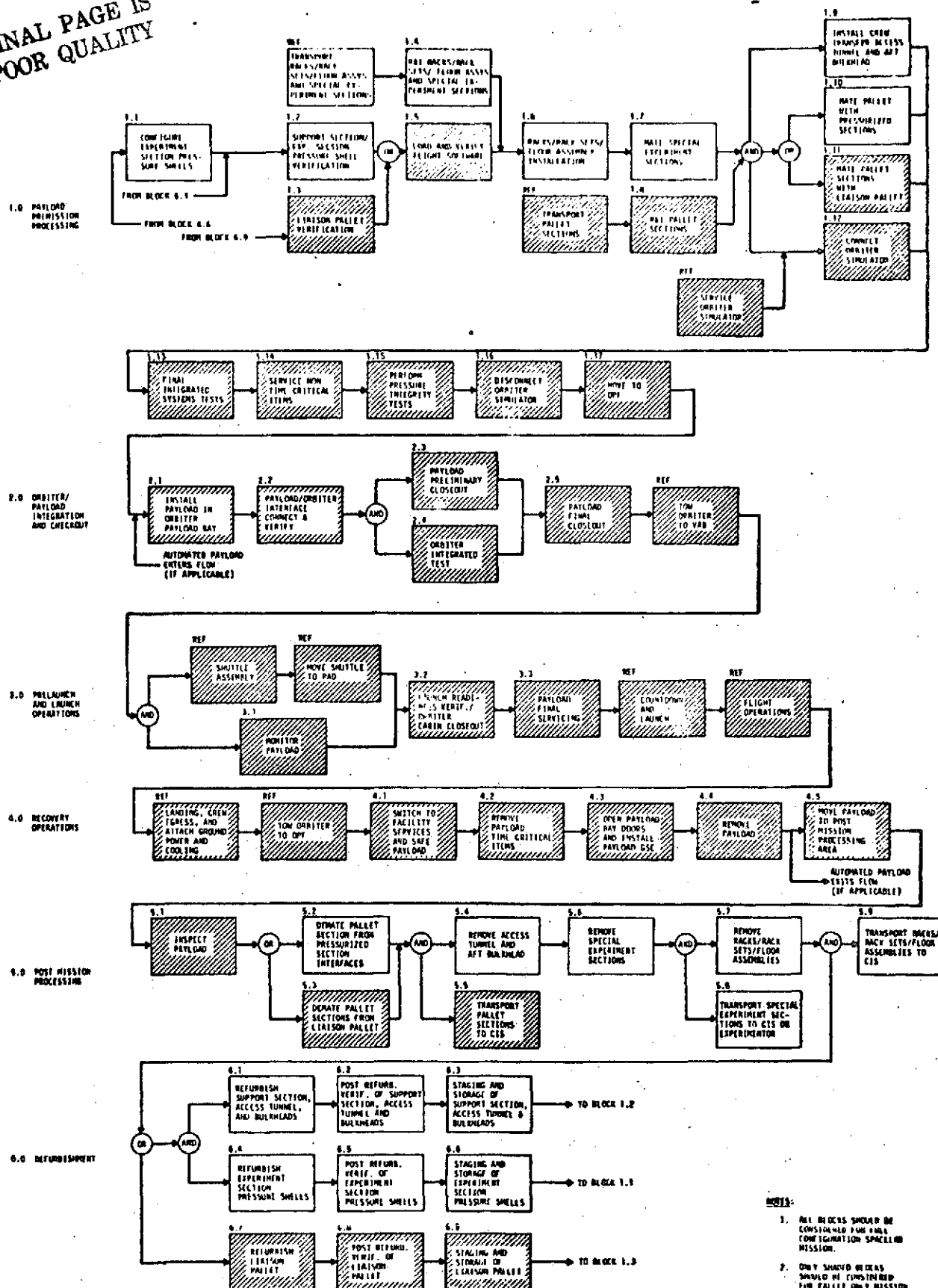
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LEVEL 0 BASELINE

SORTIE PAYLOAD FUNCTIONAL FLOW

SORTIE PAYLOAD

Block 1.1 Configure Experiment Section Pressure Shells

(This block removes the Experiment Section Pressure Shells from storage, mates the proper components of the Experiment Section Pressure Shells, and configures the Shells for receipt of racks/ rack sets/ floor assemblies. As a ground rule, these activities are not applicable to the facility requirements document.)

Block 1.2 Support Section/Exp. Section Pressure Shell Verification

(This block verifies structural mating of Support Section and Experiment Section Pressure Shell, the interfaces between the two sections, and ends with the Spacelab ready for experiment installation and ready for experiment installation and ready for loading of flight software. As a ground rule, these activities are not applicable to the facility requirements document.)

Block 1.3 Liaison Pallet Verification

(The definition of the Liaison Pallet has changed, so this block is not applicable.)

- Block 1.4 Receive and Inspect Racks/ Rack Sets/ Floor Assemblies and Special Experiment Sections
- Block 1.4.1 Racks/ Rack Sets/ Floor Assemblies and Special Experiment Sections (hereafter referred to as Experiment Equipment) arrive at launch site via _____.
- Block 1.4.2 Unload Experiment Equipment from commercial ^{CARRIER}~~carrier~~ and place in temporary storage.
- Block 1.4.3 Transport Experiment Equipment from temporary storage to receiving area of PPF.
- Block 1.4.4 Unpack Experiment Equipment and place on moveable dolly.
- Block 1.4.4.1 Transport Experiment Equipment shipping containers to temporary/ long-term storage.
- Block 1.4.5 Conduct visual inspection and record transport sensor reading to verify post-transportation integrity of Experiment Equipment.
- Block 1.4.5X ^{NODE} Contingency ~~node~~ for malfunction correction.
- Block 1.4.6 Move Experiment Equipment to checkout area in PPF.
- Block 1.4.20 Experiment Equipment GSE arrives at launch site via _____.
- Block 1.4.21 Unload GSE from commercial carrier and place in temporary storage.
- Block 1.4.22 Transport GSE from temporary storage to receiving area of PPF.
- Block 1.4.23 Unpack GSE and place on moveable dolly.
- Block 1.4.23.1 Transport GSE shipping containers to temporary storage.
- Block 1.4.24 Conduct visual inspection and record transport sensors to verify post-transportation integrity of GSE.
- Block 1.4.25 Move GSE to checkout area of PPF.

Block 1.5

Load and Verify Flight Software

(It is felt that this block includes some interface with Experiment Equipment, and as the Experiment Equipment has not yet been installed in the Spacelab, this block will be inserted later in the flow. ~~o~~ See Block 1.5 insert between Blocks 1.12 and 1.13.)

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Block 1.6

Racks/Rack Sets/Floor Assembly Installation

Note:

This block has been changed to include a verification test of Racks/Rack Sets/ Floor Assemblies interfaces prior to installation into the Spacelab. The justification of this change is that malfunction detection is more economical and has less probability of impacting the Shuttle launch schedule when performed on a "build-up" basis instead of on a "system" basis. In addition, the equipments have not been functionally checked since launch site arrival, and to delay the check until after installation into the Spacelab appears to invite duplication of installation/removal activities and resulting increases in time requirements and costs for ground operations.

- 1.6.1 Perform functional check and calibration of GSE.
- 1.6.1X Contingency node for malfunction correction.
- 1.6.2 Connect GSE to Experiment Equipments requiring calibration, and calibrate Experiment Equipments.
- 1.6.2X Contingency node for malfunction correction.
- 1.6.3 Connect GSE to Experiment Equipment interfaces.
- 1.6.4 Perform verification tests of Experiment Equipment interfaces.
- 1.6.4X Contingency node for malfunction correction.
- 1.6.4.1 Perform mechanical interface verification tests.
- 1.6.4.2 Perform fluid interface verification tests.
- 1.6.4.3 Perform electrical interface verification tests.
- 1.6.5 Remove Experiment Equipment verification GSE.
- 1.6.6 Inspect Experiment Equipment to verify configuration is correct for installation into Spacelab.
- 1.6.6X Contingency node for malfunction correction.
- 1.6.7 Attach GSE handling slings and obtain and position materials handling equipment.

- 1.6.8 Move Experiment Equipment into Spacelab and secure all interfaces; remove GSE handling slings and materials handling equipment.
- 1.6.8X Contingency node for malfunction correction.
- 1.6.8.1 Connect mechanical interfaces.
- 1.6.8.2 Connect fluid interfaces.
- 1.6.8.3 Connect electrical interfaces
- 1.6.9 Perform functional check and calibration of GSE as required.
- 1.6.10 Connect GSE to Experiment Equipment.
- 1.6.11 Perform verification tests of Experiment Equipment interfaces.
- 1.6.11X Contingency node for malfunction correction.
- 1.6.11.1 Perform mechanical interface verification tests.
- 1.6.11.2 Perform fluid interface verification tests.
- 1.6.11.3 Perform electrical interface verification tests.
- 1.6.12 Remove Experiment Equipment verification GSE.

NOTE: The concept is to functionally verify the interfaces of the individual Racks/Rack Sets/Floor Assembly prior to installation into the Experiment Module, and after installation, to perform a functional end-to-end verification of the installed equipment.

Block 1.6.1 through Block 1.6.5 cover the before-installation verification, and Block 1.6.9 through Block 1.6.12 cover the after-installation verification.

Block 1.7 Mate Special Experiment Sections

(The flow of this block is similar to that of Block 1.6 -
Racks/Rack Sets/ Floor Assembly Installation - and is not
repeated here.)

- Block 1.8 Receive and Inspect Pallet Sections
- 1.8.1 Pallet Sections arrive at launch site via _____.
- 1.8.2 Unload Pallet Sections from commercial carrier and place in temporary storage.
- 1.8.3 Transport Pallet Sections from temporary storage to receiving area of PPF.
- 1.8.4 Unpack Pallet Sections and place in Holding Fixture (moveable, and simulates Orbiter Cargo Bay)
- 1.8.4.1 Transport Pallet Sections Shipping Containers to temporary/long term storage.
- 1.8.5 Conduct visual inspection, and record transport sensor readings to verify post-transportation integrity.
- 1.8.5X Contingency node for malfunction connection.
- 1.8.6 Move Pallet Sections (in Holding Fixture) to checkout area in PPF.
- 1.8.20 Pallet Sections GSE arrives at launch site via _____.
- 1.8.21 Unload GSE from commercial carrier and place in temporary storage.
- 1.8.22 Transport GSE from temporary storage to receiving area of PPF.
- 1.8.23 Unpack GSE, and place on dolly.
- 1.8.23.1 Transport GSE shipping containers to temporary storage.
- 1.8.24 Conduct visual inspection and record transport sensor readings to verify post-transportation integrity.
- 1.8.24X Contingency node for malfunction correction.
- 1.8.25 Move GSE to checkout area of PPF.

Block 1.9

Install Crew Transfer Access Tunnel and Aft Bulkhead

(This block is not applicable to study.)

Block 1.10 Mate Pallet with Pressurized Sections

Note: This block has been changed to include a verification test of the Pallet Sections interfaces prior to connecting the Pallet Sections to the Pressurized Sections. The justification for this change is the same as contained in Block 1.6 above.

- 1.10.1 Perform functional check and calibration of GSE.
- 1.10.1X Contingency node for malfunction correction.
- 1.10.2 Connect GSE to Pallet Sections requiring calibration, and calibrate Pallet Sections.
- 1.10.2X Contingency node for malfunction correction.
- 1.10.3 Connect GSE to Pallet Sections interfaces.
- 1.10.4 Perform verification tests of Pallet Sections interfaces.
- 1.10.4X Contingency node for malfunction correction.
- 1.10.4.1 Perform mechanical interface verification tests.
- 1.10.4.2 Perform fluid interface verification tests.
- 1.10.4.3 Perform electrical interface verification tests.
- 1.10.5 Remove Pallet Sections verification GSE.
- 1.10.6 Inspect Pallet Sections to verify configuration is correct for mating with Pressurized Sections.
- 1.10.6X Contingency node for malfunction correction.

Note: The Pressurized Sections interfaces which mate with the Pallet Sections are assumed to have been verified in Block 1.2/1.9.

- 1.10.7 Mate Pallet Sections with Pressurized Sections.
- 1.10.7X Contingency node for malfunction correction.
- 1.10.7.1 Connect mechanical interfaces.
- 1.10.7.2 Connect fluid interfaces.
- 1.10.7.3 Connect electrical interfaces.
- 1.10.8 Perform functional check and calibration of GSE as required

- 1.10.9 Connect GSE to Pressurized Sections and Pallet Sections as required to perform verification tests of interfaces between Pressurized Sections and Pallet Sections.
- 1.10.10 Perform verification tests of interfaces.
- 1.10.10X Contingency node for malfunction correction.
- 1.10.10.1 Perform mechanical interface verification tests.
- 1.10.10.2 Perform fluid interface verification tests.
- 1.10.10.3 Perform electrical interface verification tests.
- 1.10.11 Remove verification test GSE.

Note: It should be noted that if any equipment change-out is required in the Pressurized Sections during Block 1.10 activities, the equipment must access the Pressurized Sections either via the crew transfer access tunnel or the access hatch in the aft bulkhead. It is recommended that installation of the aft bulkhead be delayed until after completion of Block 1.14 (Service Non-Time Critical Items) and prior to Block 1.15 (Perform Pressure Integrity Tests). This change in functional flow would permit equipment change-out resulting from Block 1.13 (Final Integrated Systems Tests), and thence in Block 1.15 (Perform Pressure Integrity Tests), the interface between the aft bulkhead and Pallet Sections would be verified during the pressure integrity tests.

Block 1.11 Mate Pallet Sections with Liaison Pallet

(The definition of the Liaison Pallet has changed, so
this block is not applicable.)

Block 1.12

Connect Orbiter Simulator

(This block is not applicable to the study. However, the following comments are offered.

It is recommended that the forward bulkhead of the "Holding Fixture" duplicate the forward end of the Orbiter Cargo Bay, and this forward bulkhead of the "Holding Fixture" then serves as the interface connection between the Spacelab and Orbiter. The "other" equipment of the Orbiter Simulator would be a series of rack-mounted equipments on dollies which simulate the Orbiter PSS station and the payload equipment which is located in the PSS station/Orbiter cabin.

The forward bulkhead of the "Holding Fixture" would have provisions for mounting the manipulator in case functional verification tests between the manipulator and portions of the Sortie Lab are accomplished during payload ground operations in the PPF.)

Block 1.5 Load and Verify Flight Software

All equipment is now assembled for flight software verification; that is, Orbiter Simulator as defined in Block 1.12 contains necessary equipment located in Orbiter, and Support and Experiment Modules and pallets are complete, so that the software can be exercised through the data channels. It is anticipated that the software verification activity will be conducted ^{BY} launch site personnel, and therefore these activities are not detailed here.

Block 1.13 Final Integrated Systems Tests

(This block verifies the interface between the Orbiter Simulator and those Spacelab elements which mate with the Orbiter Simulator. This definition is in keeping with the groundrule of verifying interfaces at the launch site, and since all interfaces within the Spacelab have previously been verified in the functional flow processing, only the interface between the Orbiter Simulator and Spacelab requires verification during the final integrated systems tests. The interfaces identified below are taken from JSC 07700, Volume XIV, "Payload Accommodations". The test activities are not detailed here; however, a generalized approach is contained in Block 1.13.5.)

Block 1.13.1 Verify Structural/Mechanical interfaces.

Block 1.13.1.1 Mechanical verification of transfer tunnel fitting on Payload Bay Hatch.

Block 1.13.1.2 Mechanical, fluid, electrical verification of Service Panel connections on Spacelab.

Block 1.13.2 Verify avionics interfaces.

Block 1.13.2.1 Verify electrical interfaces of GN&C subsystem.

Block 1.13.2.2 Verify electrical interfaces of Data Processing & Software Subsystem.

Block 1.13.2.3 Verify electrical (hardwire and RF) interfaces of communications and tracking subsystem.

Block 1.13.3 Verify electrical power subsystem interfaces.

Block 1.13.4 Verify the Environmental Control and Life Support (ECLS) subsystem interfaces.

Block 1.13.4.1 Verify the Atmospheric Revitalization Subsystem (ARS) interfaces.

Block 1.13.4.2 Verify the Active Thermal Control Subsystem (ATCS) interfaces.

Block 1.13.5 Typical interface verification test.

Block 1.13.5.1 Perform functional check and calibration of GSE as required.

Block 1.13.5.X Contingency mode for malfunction correction.

Block 1.13.5.2 Connect GSE to interfaces and conduct verification tests.

Block 1.13.5.3 Disconnect GSE and connect interfaces.

Block 1.13.5.4 Perform verification tests of interfaces.

Block 1.13.5.4.X Contingency mode for malfunction correction.

Block 1.13.5.4.1 Perform mechanical interface verification tests.

Block 1.13.5.4.2 Perform fluid interface verification tests.

Block 1.13.5.4.3 Perform electrical interface verification tests.

Block 1.13.5.5 Remove verification tests GSE.

Block 1.14 Service Non-Time Critical Items

(This Activity Services the Spacelab (not covered here) and the experiments with non-time critical items. For experiments, the experiment equipment in Orbiter Cabin, the experiment equipment in the Experiment Module, and the experiment equipment mounted on pallets are included in the functional tasks which follow.)

Block 1.14.1 Perform functional check, calibration, and service GSE as required.

Block 1.14.1X Contingency mode for malfunction correction.

Block 1.14.2 Connect GSE to servicing interfaces.

Block 1.14.2X Contingency mode for malfunction correction.

Block 1.14.3 Perform servicing activity, including fluids, tapes, films, etc., and storage of non-time critical flight supplies.

Block 1.14.4 Perform verification inspection of non-time critical servicing and flight supplies, with emphasis on equipment remaining secure when payload is rotated to vertical position in one-g environment.

Block 1.14.4X Contingency mode for malfunction correction.

Block 1.14.5 Disconnect Servicing GSE.

Block 1.15 Perform Pressure Integrity Tests

(As written, this block appears to duplicate interface verification tests which have been completed in Block 1.13 - Final Integrated Systems Tests. For instance, Block 1.13 has verified all element interfaces and subsystems performance, and it is assumed that these tests would have located and corrected any pressure leaks in all system/subsystem plumbing which is defined as a portion of Block 1.15 Pressure Integrity Tests. In keeping with the ground rule of eliminating duplicate tests, it is suggested that the activities in this block be limited to pressure integrity tests of the access tunnel, the Support Module, and the Experiment Module. Such a pressure integrity test would not involve the experiments, and therefore is not detailed here.)

Block 1.16 Disconnect Orbiter Simulator

(This activity disconnects the interfaces between Orbiter Simulator and Spacelab, and secures the interfaces on the Spacelab. This activity does not involve experiments, and therefore is not detailed here.

However, the Orbiter Simulator may contain rack-mounted experiment equipment which is located in the Orbiter cabin during the flight mission. The processing of this equipment follows below, and is defined as "Cabin Experiment Equipment".)

Block 1.16.1 Disconnect interface between Orbiter Simulator and Cabin Experiment Equipment.

Block 1.16.2 Install protective devices on Cabin Experiment Equipment interfaces, and secure interfaces for transport.

Block 1.16.3 Install protective covers on Cabin Experiment Equipment, ~~and~~ and move equipment clear of Orbiter Simulator.

Block 1.17 Move to OFF

(This activity moves the payload from the Payload Processing Facility (PPF) to the Orbiter Processing Facility (OPF). It involves a transporter, protective covers, and GSE required during towing operations from PPF to OPF. (Three (3) hours tow time allocated.) The transporter is assumed to be the Cargo Bay Simulator previously described. Support for experiments during the towing operation can be divided into two classes, namely support of experiments located in the Experiment Module which is normally furnished by an active Support Module which, in turn, is supported by an active Orbiter, and support of experiments pallet-mounted which, except for cleanliness support, receives support in a similar manner. Supplemental support available to the payload in the form of igloos and the like is not considered at this time.

The experiment support required during towing then may be classified as:

- o Orbiter derived
- o Cleanliness requirements

It is assumed that GSE which duplicates the Orbiter support is available, and can be located to interface with the forward bulkhead of the Cargo Bay Simulator during tow operations.

The experiment cleanliness requirements within the Experiment Module will be satisfied by the closed system (Access tunnel hatches closed). The Cabin Experiment Equipment is transported separately, and not with the Spacelab.

The preparation of the Spacelab within the Cargo Bay Simulator and the towing operation from the PPF to the OPF is not considered an experiment-related function, and therefore is not detailed here.

Block 1.17 (continued)

There remains the cleanliness requirements for the pallet-mounted experiments which are detailed below.))

Block 1.17.1 Perform functional check, calibration, and service GSE as required.

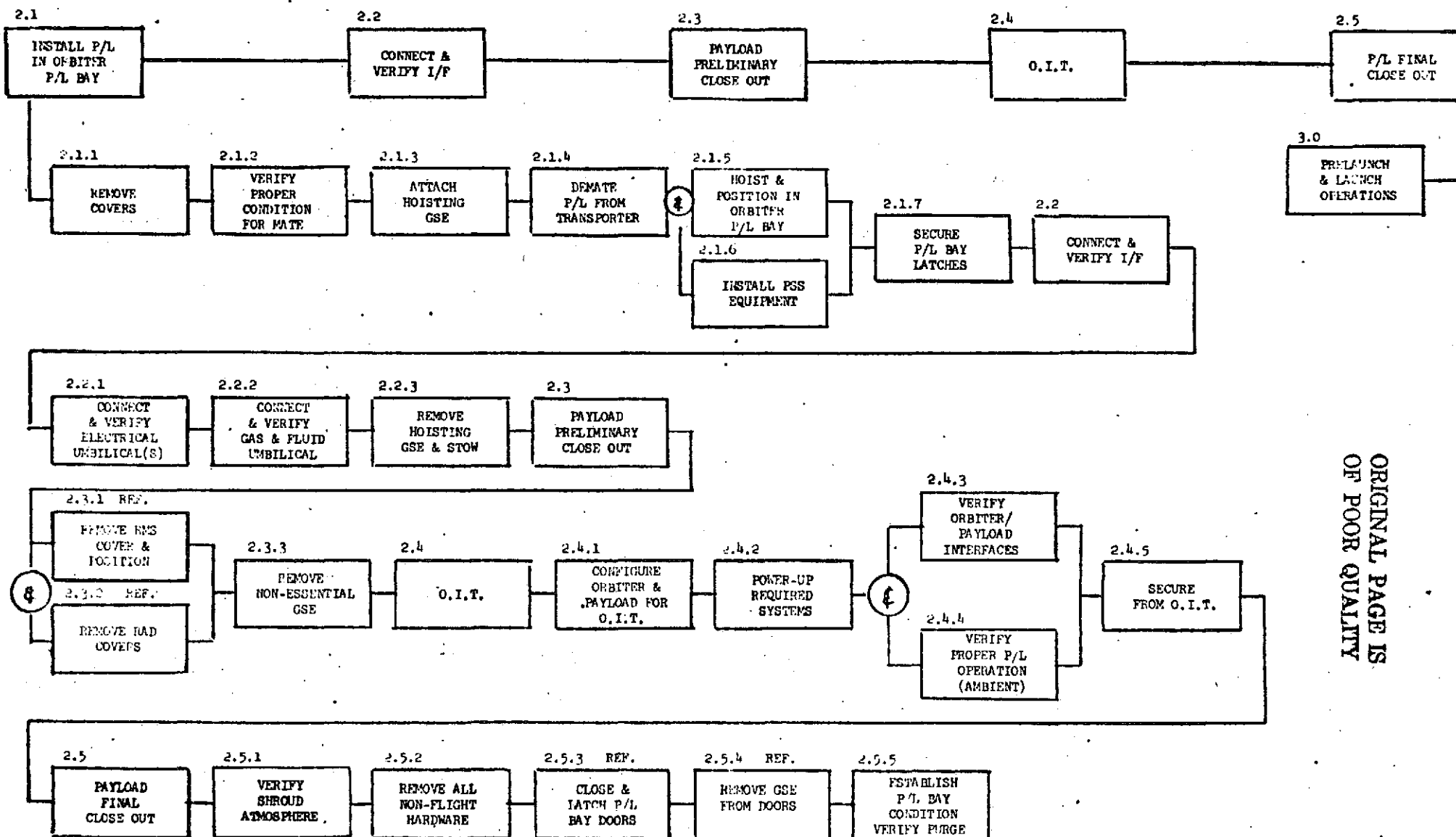
Block 1.17.1X Contingency mode for malfunction correction.

Block 1.17.2 Position GSE on trailer which accompanies Cargo Bay Simulator during tow from PPF to OPF.

Block 1.17.3 Install protective covers on pallet-mounted experiments.

Block 1.17.4 Connect GSE to protective covers.

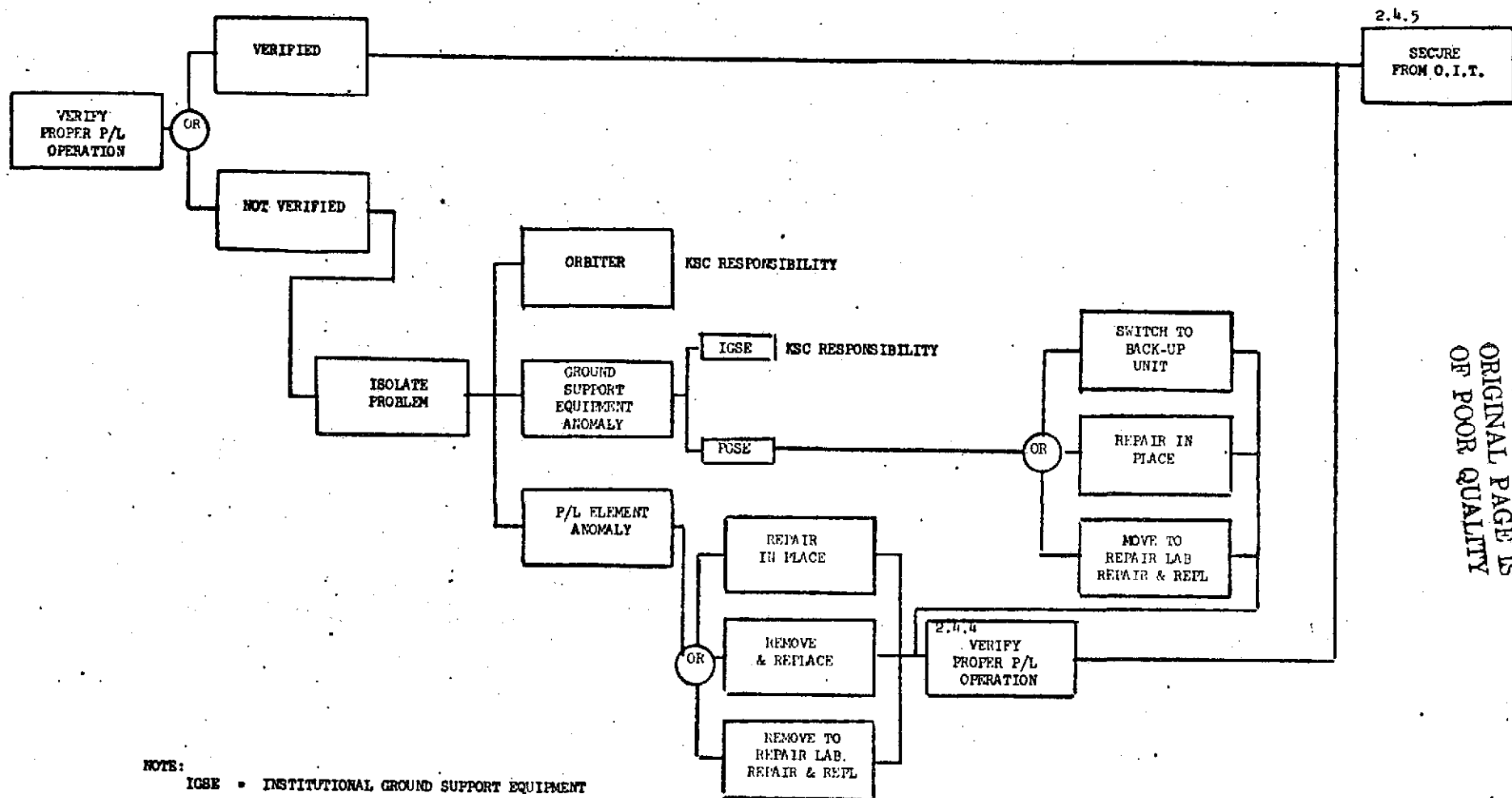
Block 1.17.5 Power up GSE and supply cleanliness requirements, and monitor GSE output.



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BLOCK 2.0

ORBITER/PAYLOAD INTEGRATION AND CHECKOUT



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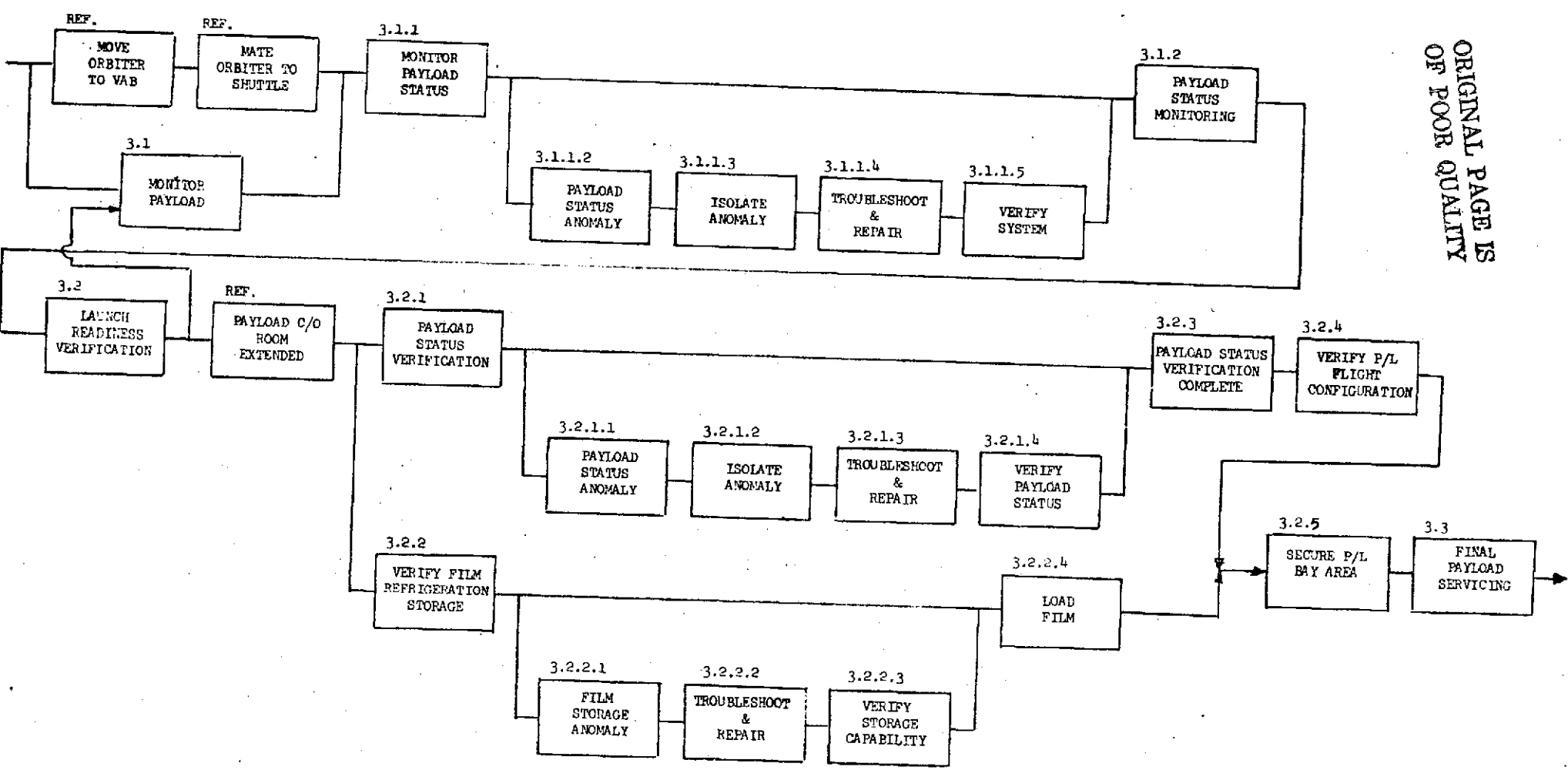
- IGSE • INSTITUTIONAL GROUND SUPPORT EQUIPMENT
- PGSE • PAYLOAD PECULIAR GROUND SUPPORT EQUIPMENT

BLOCK 2.0

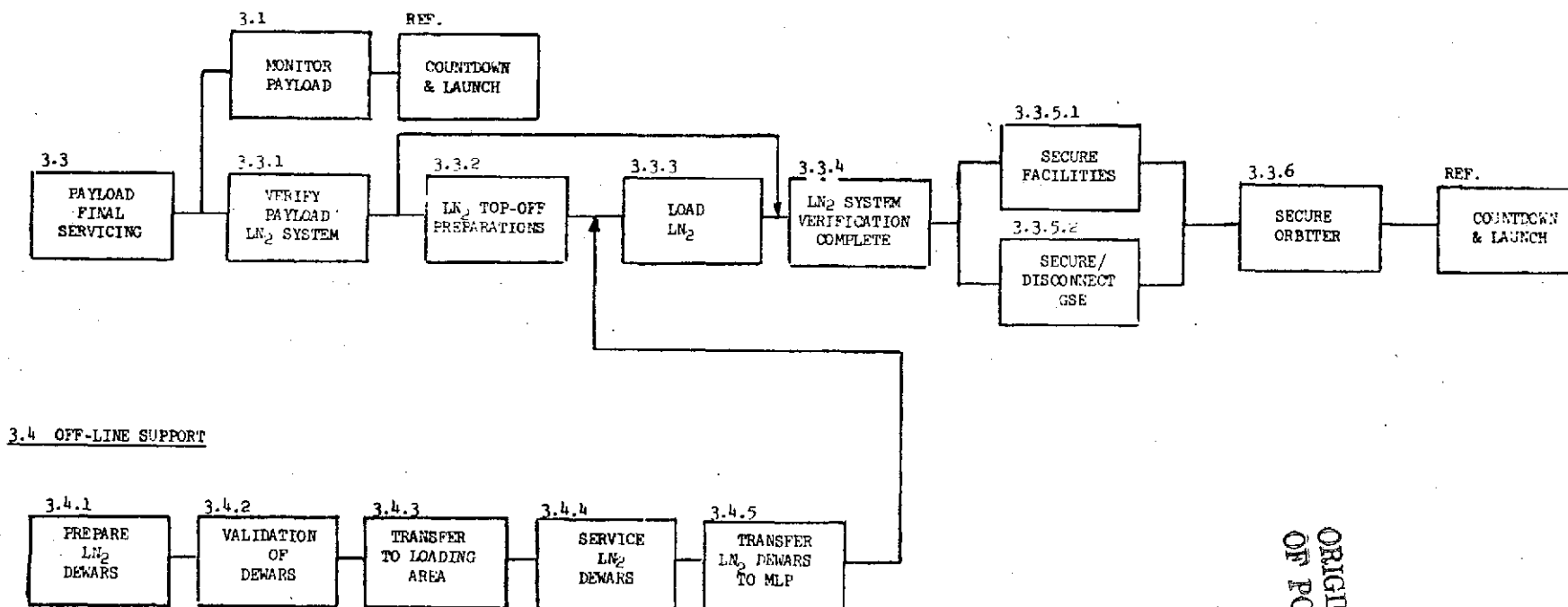
TYPICAL ANOMALY FUNCTIONAL LOOP

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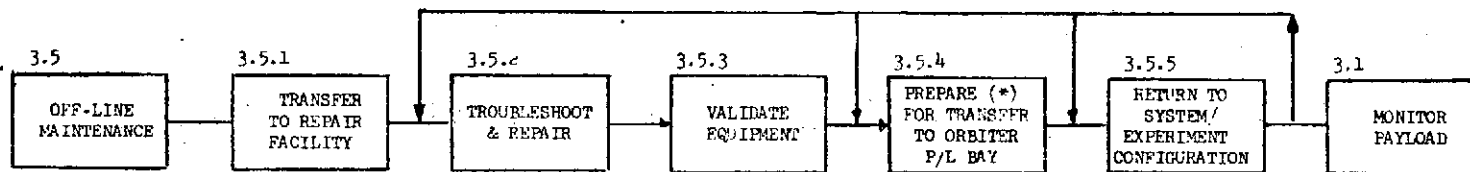


BLOCK-3.1 MONITOR PAYLOAD AND 3.2 LAUNCH READINESS VERIFICATION



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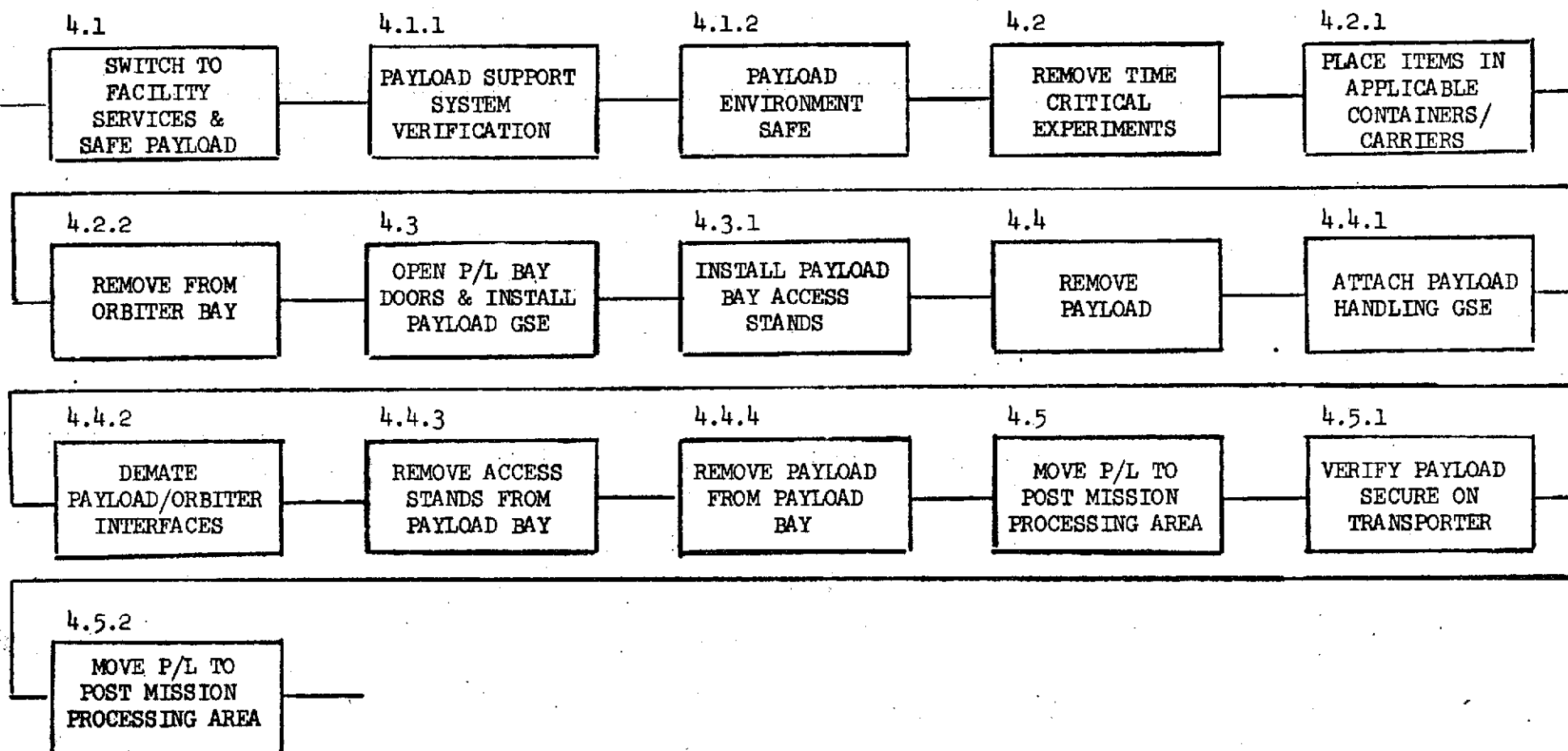
BLOCK 3.3 FINAL PAYLOAD SERVICING



BLOCK 3.0 - PRELAUNCH AND LAUNCH OPERATIONS

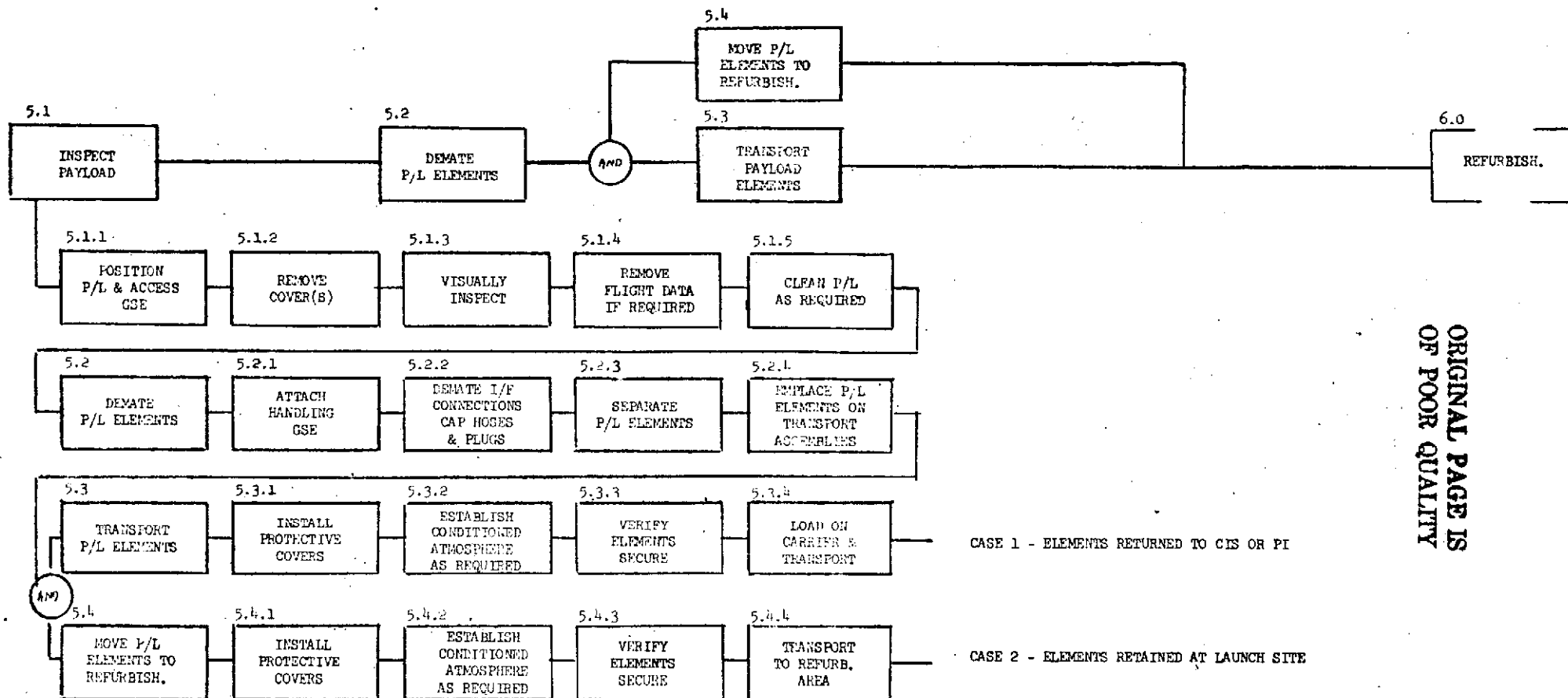
TYPICAL EXPERIMENT/PAYLOAD/CSE - OFF-LINE MAINTENANCE FLOW

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BLOCK 5.0

POST MISSION PROCESSING



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